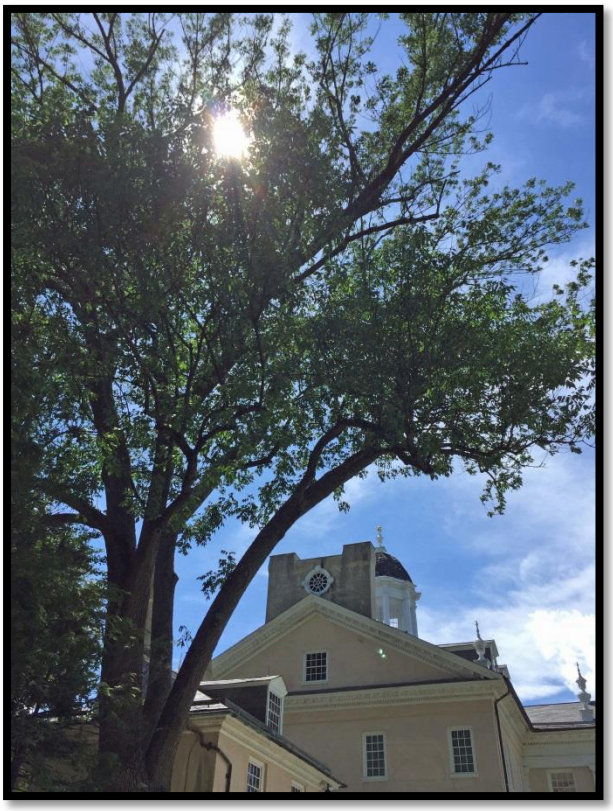
Biological Evaluation of Ash Trees
At
Hampton
National Historic Site



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Photos: *Karen Felton, USDA FS, Morgantown, WV*

Abstract

In June 2015, Forest Health Protection personnel from the Forest Service, U.S. Department of Agriculture, Northeastern Area, State and Private Forestry Field Office in Morgantown, WV, and personnel from Hampton National Historic Site (Hampton NHS) conducted a survey of the ash trees at Hampton NHS, Towson, MD. The purpose of the survey was to see if emerald ash borer (EAB), *Agrilus planipennis* Fairmaire, was present; assess the health of the ash trees; and determine the need for management activities at the Park. No EAB were detected at the time of the survey. In June 2015, EAB was found within 6 miles of Hampton NHS. It is recommended that a comprehensive ash management plan be developed and a chemical prevention treatment plan be put into place to protect these high value ash trees. We also recommend the release of biological control agents if it does not conflict with the Park's management plan.

Purpose and Need

The Forest Health Protection unit of the Forest Service, Northeastern Area, State and Private Forestry Field Office (MFO) in Morgantown, WV, received a request in the spring of 2015 from Amanda Ramey, Gardener/IPM Coordinator at Hampton National Historic Site, and Casey Reese, Regional IPM Coordinator, Northeast Region, USDI National Park Service, to conduct a biological evaluation in regards to the rapidly approaching EAB towards the Park. We also received an email from Tina Cappetta, Hampton NHS's Superintendent supporting the importance of implementing available emerald ash borer management options in order to protect and maintain the ash resources at Hampton NHS.

In June 2015, Forest Health Protection personnel from MFO and Hampton NHS conducted a survey to inventory the ash (*Fraxinus* spp.); assess the health of the ash trees; and determine the need for management activities at the Park.

Species Evaluation/Background

Emerald ash borer (EAB), *Agrilus planipennis* (Fairmaire), is a wood-boring beetle from Eastern Asia (Poland and McCullough 2006) that is causing severe mortality in North American ash (Tluczek et al.2011). EAB affects all species and diameter classes of ash and often kills both healthy and stressed trees within 3 to 5 years of their becoming infested (Siegert et al. 2006).

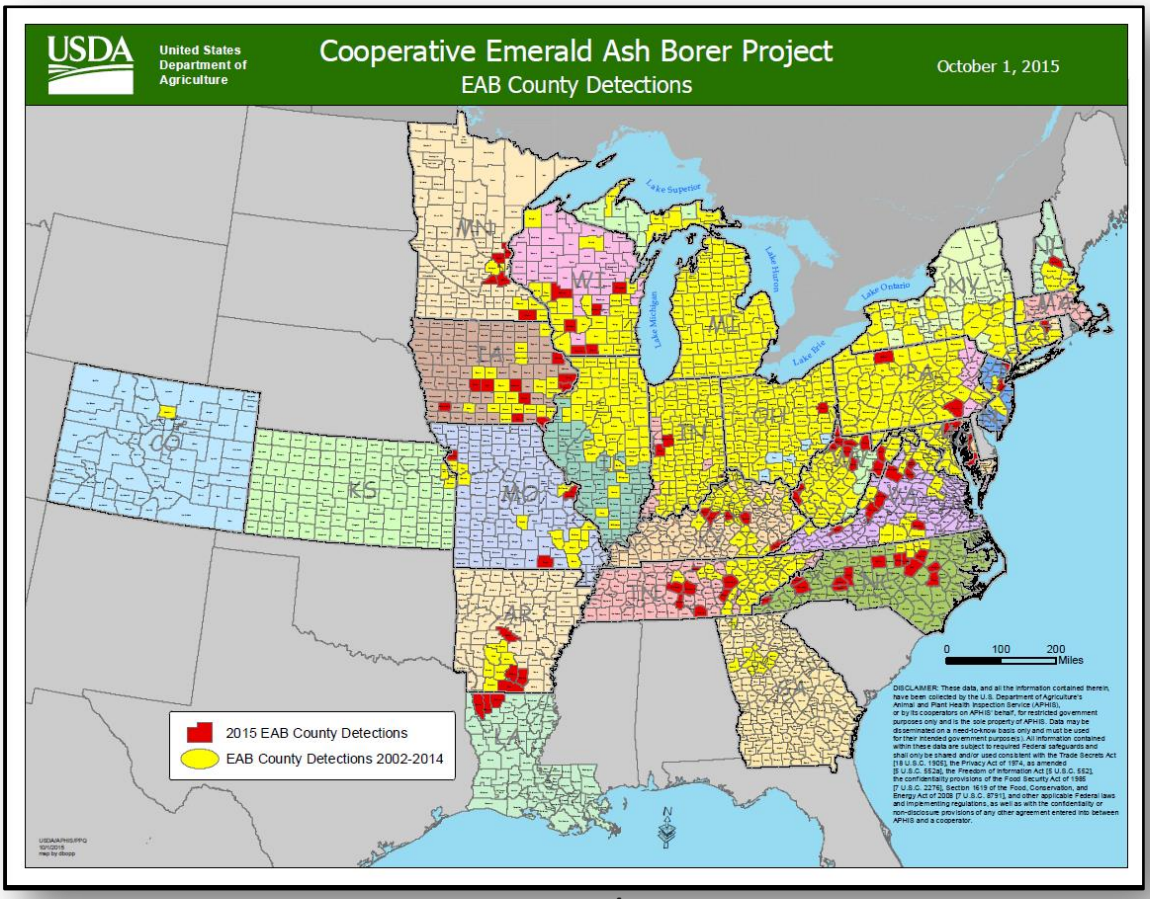
Based on data from the USDA Animal and Plant Health Inspection Service, EAB emerges around mid-June and is present through mid-August (www.emeraldashborer.info). Adult beetles are slender, elongate, and bright green, and feed on ash foliage in patches along the leaf margins (Kovacs *et al.* 2010). Adult beetles usually live for about 3 weeks, and females lay about 60-90 eggs (McCullough and Katovich 2004). Eggs hatch in 7-10 days, and larvae chew through the

bark and feed on phloem and outer sapwood for several weeks, creating S-shaped galleries packed with frass (Bauer et al. 2004). Larvae are white to cream colored, have 10 segments, and are flattened. Larvae overwinter in shallow chambers in the outer sapwood or bark on thick-barked trees (Bauer et al. 2004). EAB pupate in late April or May, and adults emerge 1-2 weeks after pupation through D-shaped exit holes (McCullough and Katovich 2004).

In addition to causing severe economic damage, there are ecological consequences associated with the loss of ash from North American forests. Studies show that ash trees provide food and habitat for several bird and mammal species (Faanes 1984, Rumble and Gobeille 1998). Forty-three native arthropod species are at high risk due to their association with ash for breeding or feeding (Gandhi et al. 2010). Ash also contributes to nutrient cycling in hardwood forests (Reiners and Reiners 1970).

EAB was first found in the Detroit, Michigan/Windsor, Ontario area in 2002. To date, EAB has been detected in 25 states including: Michigan, Arkansas, Colorado, Connecticut, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Massachusetts, Minnesota, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, Wisconsin, as well as Canadian provinces of Ontario and Quebec (Figure 1).

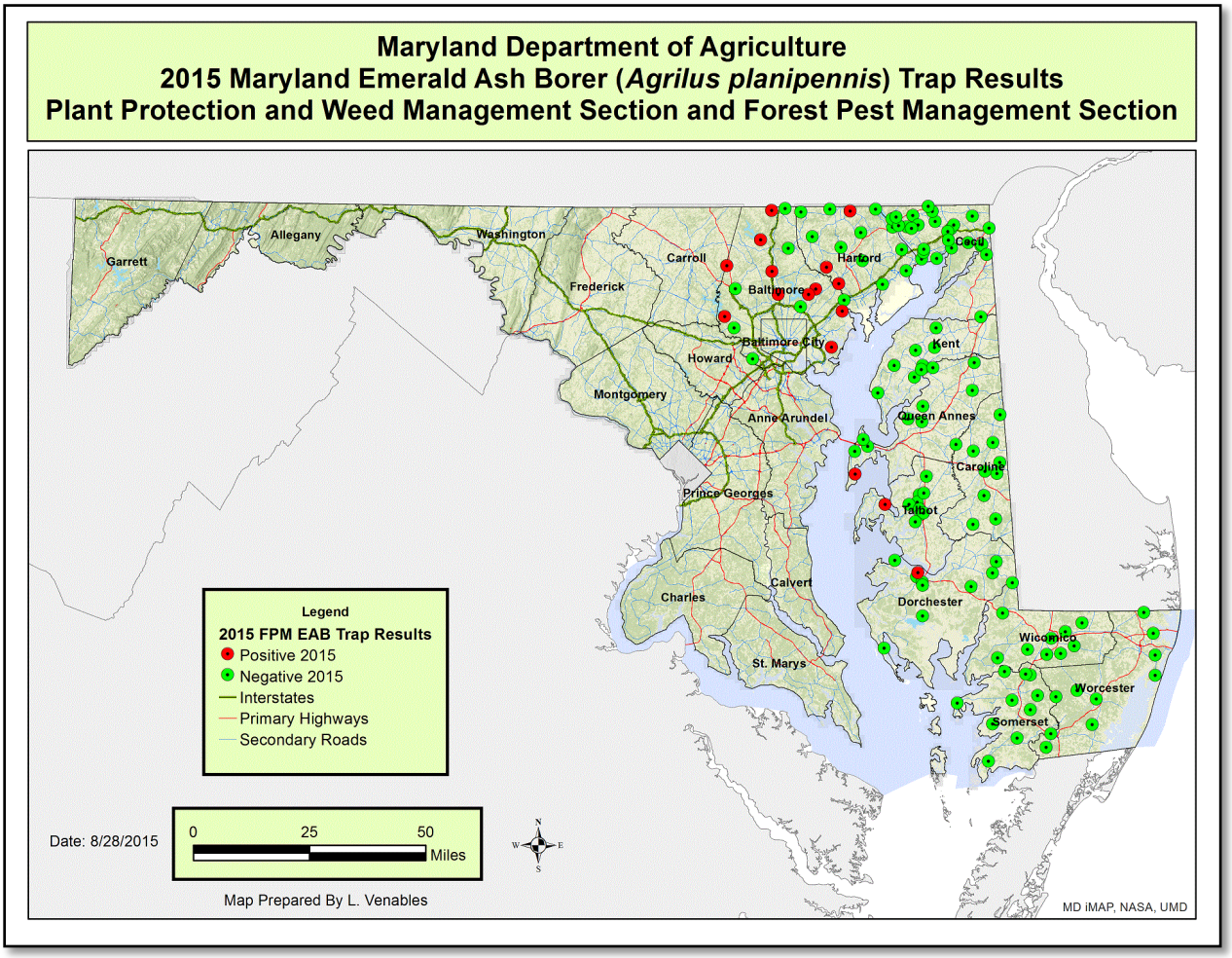
Figure 1. *Emerald ash borer county detections as of October 1, 2015 (USDA APHIS PPQ 2015).*



Emerald ash borer was first discovered in Prince George's County, Maryland in 2003. Aggressive eradication efforts limited its spread until 2009, when outlier infestations and regional spread made eradication unlikely. As of August 1, 2015, the Animal and Plant Health Inspection Service (APHIS) added all of Maryland to the list of regulated areas in response to an increase in EAB catches in more counties and the Eastern Shore of Maryland (Figure 2).

In June 2015, EAB was found within 6 miles of Hampton NHS (-Amanda Ramey, personal communication, USDI NPS "June, 2015").

Figure 2. *2015 Maryland emerald ash borer trap results (MDA Forest Pest Management 2015).*



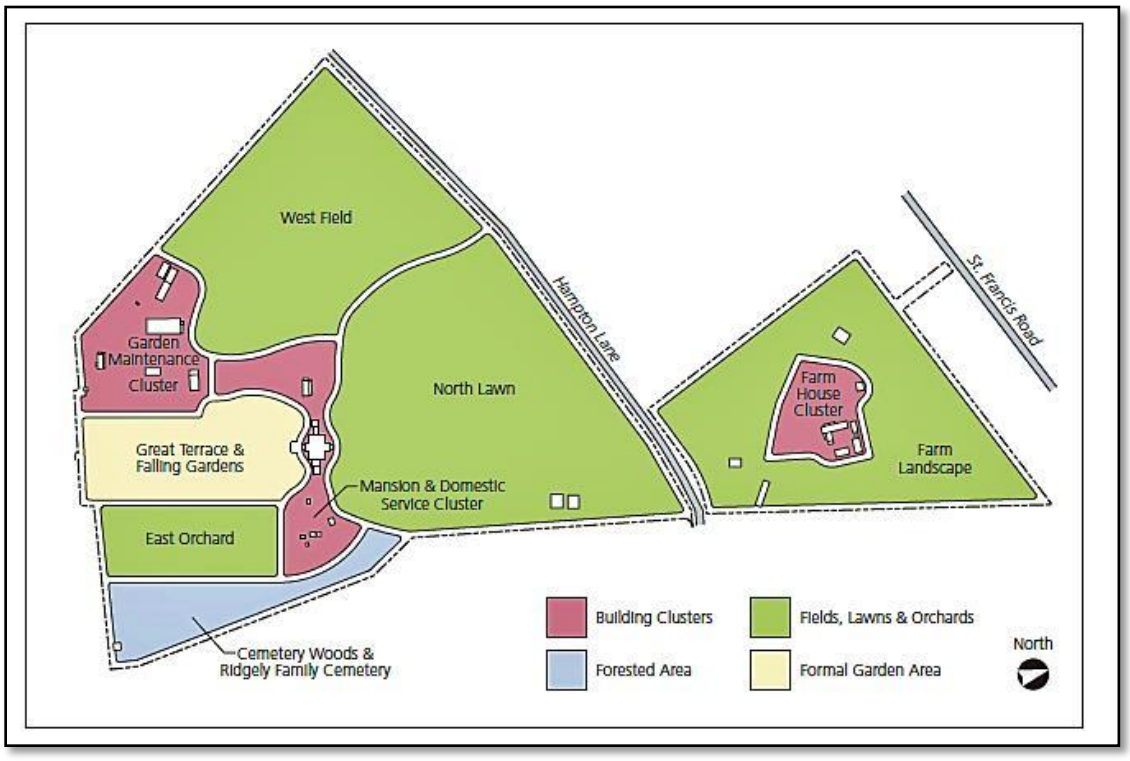
Project Location/Description

Hampton National Historic Site, in the Hampton area north of Towson, Baltimore County, Maryland, USA, preserves a remnant of a vast 18th-century estate, including a Georgian manor house, gardens, grounds, and the original stone slave quarters. The estate was owned by the

Ridgely family for seven generations, from 1745 to 1948. The Hampton Mansion was the largest private home in America when it was completed in 1790 and today is considered to be one of the finest examples of Georgian architecture in the U.S. Its furnishings, together with the estate's slave quarters and other preserved structures, provide insight into the life of late 18th-century and early 19th-century landowning aristocracy. In 1948, Hampton (62 acres) was the first site selected as a National Historical Site for its architectural significance by the U.S. National Park Service. Hampton NHS is comprised of two distinct components: the 48-acre Mansion landscape, located to the south of Hampton Lane, and the 14-acre farm landscape, located to the north. The grounds were widely admired in the 19th century for their elaborate parterres or formal gardens, which have been restored to resemble their appearance during the 1820s. Several trees are more than 200 years old (Beagan 2014). Many of the big trees are ash trees and add to the visitor's total experience.

Hampton National Historic Site grounds include fields and lawns (North Lawn, West Field, East Orchard, and Farm Landscape), formal gardens with ornate ornamental plantings (Great Terrace and Falling Gardens), forested areas (Cemetery Woods & Ridgely Family Cemetery), and former residential and service areas (Mansion & Domestic Service Cluster, Garden Maintenance Cluster, and Farm House Cluster) (Figure 3) (Beagan 2014).

Figure 3. *Hampton National Historic Site landscape character areas (Beagan 2014).*



Hampton's diverse horticultural collection is central to the significance of the landscape. Vegetation at Hampton can be divided into four categories: woodlands, ornamental plantings (including trees, shrubs, and herbaceous plants), lawn and fields, and vegetative screens. Natural woodlands occur primarily along park boundaries. Vegetative screens enhance the historic

setting of the property by screening incompatible views of adjacent suburban development (Beagan 2014).

Within the mansion landscape, woodlands occur primarily at park boundaries, including the southern property boundary (along the Baltimore Beltway sound wall) and eastern property boundary (bordering cemetery road). These areas are delineated in the *Hampton Forest Stand Delineation and Forest Conservation Plan* (USDI NPS 2012). A 1.1-acre forest protection area was established within Cemetery Woods, along the eastern side of cemetery road, was established to mitigate disturbance of the white pine stand as a result of construction of the new Visitor Contact Station along the eastern property boundary (Beagan 2014).

Many mature specimen trees remain from the period of significance throughout the mansion landscape. The most significant trees stand along the historic entrance drive, on the Great Terrace, on the North Lawn, and in the vicinity of the Falling Gardens. Several Maryland state champion trees are growing on the mansion grounds, including cedar of Lebanon (*Cedrus lebani*), Austrian pine (*Pinus nigra*), weeping Japanese scholar tree (*Sophora japonica* 'Pendula'). The saucer magnolia (*Magnolia* x *soulangiana*) is the third largest in the state. The Biltmore ash (*Fraxinus biltmoriana*) to the north of the Orangery was also vegetatively propagated from the original state champion that used to stand in the same location (Beagan 2014).

Project Objectives

The objectives for this evaluation were to 1) determine whether or not EAB was present at the Park at the time of the survey, 2) assess the location and health of the ash, and 3) determine the need for chemical treatments to protect and maintain the ash resources.

Project Methods

In June 2015, Forest Health Protection personnel from MFO and Hampton NHS conducted a survey to inventory and assess the health of the ash trees at Hampton NHS.

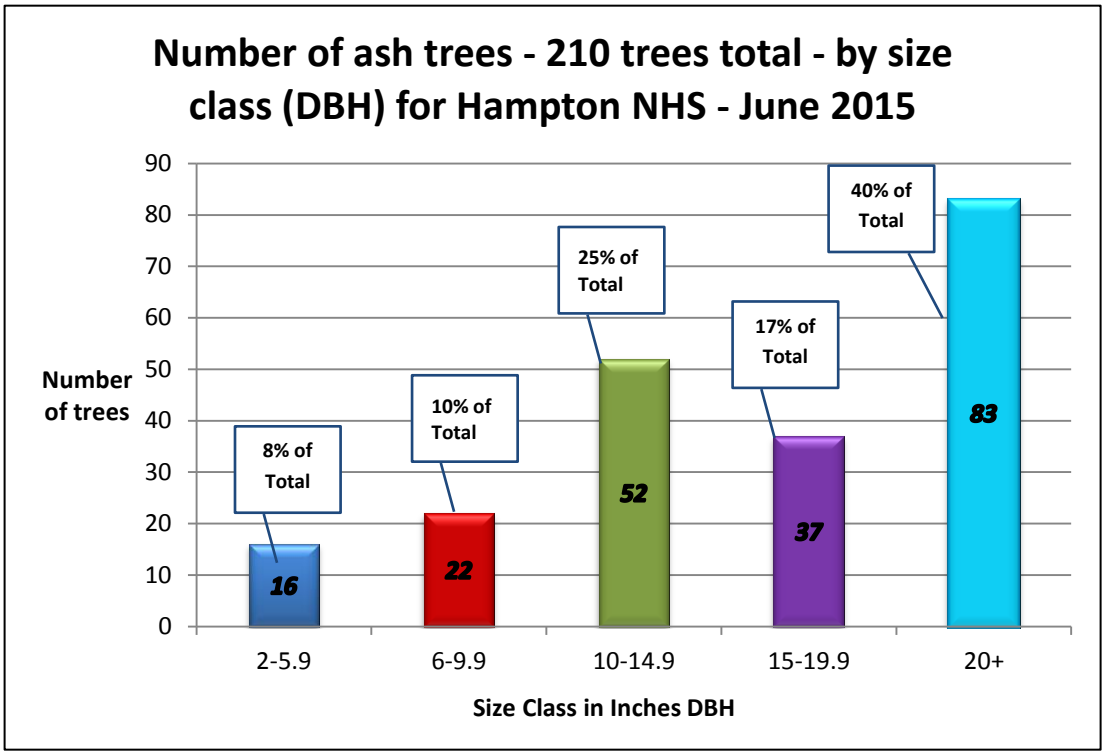
All ash trees $\geq$ 2 inch in diameter at breast height (DBH, measured at 4.5 ft. above the ground) were identified; DBH recorded; crown condition rated (dieback categories- recorded in 5% intervals); other defects noted (e.g. decay, broken branches, cavities) and visually inspected for signs and symptoms of EAB (e.g. excessive woodpecker activity, D-shaped exit holes, serpentine galleries).

Prior to the site visit in June 2015, Park personnel had already located all ash trees on site and collected DBH information.

Results

No EAB were detected at the time of the survey. Field surveys identified 210 ash trees on site at Hampton NHS. The average tree DBH was 19.4 inches and sizes ranged from 2 – 59 inches DBH. As seen in the chart below for size class information for the entire site (Figure 4), there are a lot of large diameter sized trees at HNHS.

Figure 4*. Number of ash trees and size class information for the entire site at Hampton NHS, 2015.*



Ash trees comprised about 10 % of the total open grown trees at the Park (Beagan 2014). In addition to open grown landscape trees, there are several woodlots at Hampton NHS. See Table 1 for how information is broken down by location. Percentage of ash composition was not determined in the individual woodlots.

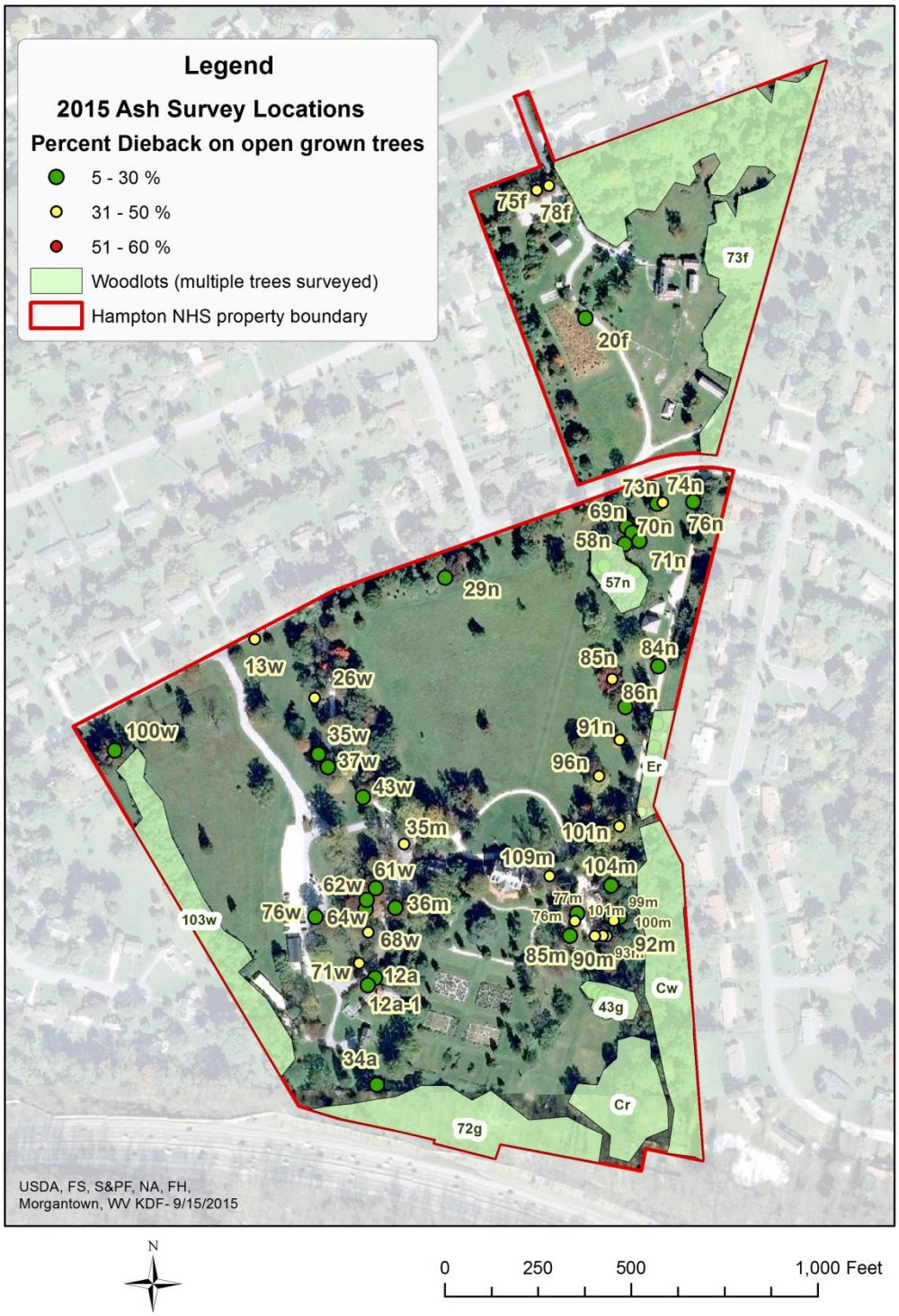
Table 1. *Number of ash trees and size information by location at Hampton NHS, 2015.*

Location/Woodlots	***Inches DBH Range***	***Number of Trees***	***Avg Inches DBH***
103w (west field, woodland buffer)	2-24	11	11.8
43g (small ash group)	10-24	6	20.8
57n (north field, stables woodlands)	8-28	13	14.8
72g (beltway, buffer woodlands)	2-24	21	10.4
73f (farmland, woodland buffers)	6-34	24	16.4
Cr (cemetery road woodlot)	2-40	38	14.2
Cw (cemetery west woodlot)	3-40	33	17.8
Er (eastside of East Road woodlot)	22-52	4	37.5
All open grown trees	4-59	60	29.0
		TOTAL = 210	

Shown in Figure 5, are the locations of the survey areas and percent dieback on the open grown ash trees. Trees surveyed in the woodlots are not shown individually on the map. Most trees at Hampton NHS were within the 5-30% dieback (176 trees) and 31-50% dieback (32 trees) categories, with only 2 trees in the > 50% category.

There were 52 trees recorded with notable decay, 17 trees with borer activity (not EAB), and 6 with some woodpecker damage. When using the recommended dieback treatment category of 30% or less, minus the trees with notable decay, borer activity and woodpecker damage; 131 ash trees are left for possible treatment. This number is only a starting point. Other comments about the trees should be taken into consideration for treatment such as cavities, poor form, proximity to buildings and powers line, and significant value of the tree to the Park; which could add individual trees back into the total or delete more from treatment.

Figure 5. *Map showing locations of the survey areas and percent dieback on the open grown ash trees at Hampton NHS, 2015.*



Discussion

The main objectives of this evaluation were to determine whether EAB was present, inventory the area, and evaluate the need for EAB management activities. No EAB were detected at the time of the survey. Even though EAB has not been detected on site, it does not mean it is not present. A newly infested tree does not display many symptoms of attack in the first years of colonization; therefore a monitoring program should be implemented.

The basic guidelines used to determine when to treat for EAB is when areas are within a quarantined county or within 10-15 miles of a known EAB infestation (Herms et al. 2014). Since EAB had been detected within 6 miles of the Park, we recommend that the Hampton NHS Staff develop a comprehensive ash/forest management plan that includes preemptive ash removal (e.g. removal of ash with poor form or defects that will eventually pose a hazard); chemical treatments; biological control releases; and replanting to ensure the preservation of the resource.

It can be difficult in finding a balance between tree removal and treatment. An ideal world would be to treat all ash trees; however treatment is labor intensive and it may not be fiscally possible to keep retreating all trees every 1-3 years, depending on the pesticide selection and local EAB densities.

For the 1.1-acre forest protection area that was established within Cemetery Woods, along the eastern side of cemetery road, individual tree treatments may be warranted. If individual tree treatments in the other woodlots or forest stands are not feasible then the following approach may be implemented: instead of trying to treat all trees, select at least 10 good specimen trees (e.g. dominate, healthy, good seed producers) at a sex ratio of at least 5:1 (females:males) and treat every 1-3 years, depending on the pesticide selection and local EAB densities (Liu and Miller 2014).

An accepted ash tree treatment requirement is that the crown dieback be 30% or less, while also taking into consideration of any other defects such as decay or poor form. Sometimes 31-60 % crown dieback may be used if the tree has been designated as treatable by using other characterizations (e.g. very high value, location) and knowing the tree will never replace the lost crown. Any tree with great than 50% dieback cannot be expected to survive even after treatment (Herms et al. 2014).

When ash trees die, they rapidly become brittle and are more prone to snap, becoming very dangerous to remove. In some cases, treating for the remaining life of a tree may not cost any more than the cost of the up-front removal, especially if the removal is too costly or too dangerous to the remover (Liu and Miller 2014). EAB kills both healthy and stressed trees within 3 to 5 years of their becoming infested (Siegert and others 2006). The Park may want to develop an ash tree removal plan to help with these issues and to stagger the cost of tree removal over the years.

Any forest understory re-plantings will require protection from herbivores, such as deer and rodents, and invasive plant species competition, until the new plantings are well established.

In some areas of EAB infestations, a small number of ash trees have been observed to be surviving EAB infestation (known as lingering ash). These trees, if they do survive over the long term, may have some natural resistance to EAB and could provide the genetic material for the next generation of ash trees.

Management Options

No Action Option:

In this option emerald ash borer is allowed to infest susceptible ash trees within the Park. Should this option be selected, it is likely that all susceptible ash trees would be attacked and die as a result of EAB. This would result in the loss of not only high value trees but native woodland trees which would result in hazard trees in public areas, and a reduction in overstory canopy

Intervention Options:

Chemical Insecticide Option

Herms and others (2014) reviewed chemical control options for EAB, which include noninvasive systemic basal trunk sprays, soil-applied systemic insecticides, trunk-injected systemic insecticides, and protective cover sprays.

- Dinotefuran (Safari®) is labeled for controlling EAB and has shown variable results. It is sprayed on the lower 5 or 6 feet of trunk.
- Soil injection of imidacloprid has shown variable results and requires careful attention to soil conditions and tree d.b.h. Soil injections should be applied 2-4 inches below the soil surface to stay available to feeder roots, the soil should be moist to facilitate uptake, and for trees larger than 15 inches d.b.h chemical amounts should be applied at the highest labeled rate or combined with other treatment methods.
- Trunk injection of emamectin benzoate in mid-May or early June provides the most consistent control of EAB, according to test trials at Michigan State and Ohio State Universities. This was the only treatment that provided multiple years of protection (up to 3 years).
- Protective cover sprays have been shown to prevent EAB from entering trees in Michigan State University studies, but have no effect on larvae feeding under the bark. Spraying the entire tree is most effective, but there is considerable drift associated with this process.
- A natural product, azadirachtin, is also available formulated as TreeAzin™, which has the potential for systemic control of EAB. This product is a natural tetranortriterpenoid

compound extracted from the seed kernels of neem (*Azadirachta indica*) (Fares et al. 1980) and is injected into the trunk of the tree.

Biological Control Option

Currently, three parasitoid wasps, including two gregarious larval endoparasitoid species (*Spathius agrili* and *Tetrastichus planipennisi*) and a solitary parthenogenic egg parasitoid (*Oobius agrili*) are available for release against EAB through the USDA APHIS EAB Biological Control Program. Guidelines have been prepared on site selection, and methods for release and recovery (USDA-APHIS/ARS/FS 2012). The release and establishment of EAB natural enemies is not likely to provide any short-term control of EAB. This long-term approach is still experimental and will likely require a complex of natural enemies to maintain EAB below damaging levels. It may be years before these parasites can perpetuate themselves sufficiently before any level of success can be determined.

Management Alternatives

For 2016, two options have been evaluated for managing EAB at Hampton NHS. The intervention options are offered based on the following objectives: 1) protect high-value ash trees and 2) protect native woodland ash trees. Each option is discussed below. With the previously described options in mind, the following alternatives are offered.

Alternatives

Alternative 1.	No action.
Alternative 2.	Select ash trees for treatment with < 30 percent decline; remove ash trees with > 30 percent decline unless the tree has been designated as treatable using other characterizations (e.g. high value, location), knowing the tree will never replace the already lost crown; and release biological control agents if it does not conflict with the Parks management plan.

Recommendations

We recommend that the Hampton NHS Staff develop a comprehensive ash/forest management plan and put a chemical suppression/prevention treatment plan into place as soon as possible. In addition, we recommend that the Hampton NHS begin a public awareness campaign about EAB and continue to annually monitor tree health conditions and survey for signs and symptoms of EAB infestations. In addition to visual surveys, it is also recommended to deploy attractant-baited traps to survey for low levels infestations of EAB. The MFO can assist Hampton NHS on preparing a monitoring plan for using the traps (e.g. quantity, trap type, trap locations, etc.), and can help Hampton NHS by preparing a display to place in their visitor center that explains their EAB management plan.

We recommend Alternative 2 based on the following considerations:

1) This alternative protects high-value ash trees and retains both large and smaller specimen trees.
2) We also recommend releasing available EAB parasitoids in infested areas that are not in proximity to chemical treatments, if this does not conflict with the Parks management plan. The establishment of these natural enemies is experimental, but may offer the opportunity for long-term control and may minimize the need for repeated chemical treatments in future years.

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